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2.2 Monitoring methods of technilogical processes in control systems

The analysis of the main trends of modern complex engineering systems shows that these systems have a number of features, among which are identified: multidimensional and the uncertainty of their behavior, hierarchy, structural similarity and redundancy basic elements and subsystems connections between them, multivariate implement the functions control at each level of these systems , territorial distributivity of the components.

Existing and projected complex technical objects (CTO) as elements of control systems are usually complex controlled object, information on functional status are transmitted as the current values of the corresponding measurement information management system. Increased complexity of objects requires a substantial increase in the number of controlled parameters that characterize the process of its operation.

Time delays and errors in management caused by wrong resolve the problem of evaluating or monitoring the condition of complex technical objects can lead to irreversible negative effects - stalling perform their tasks failures. Great extent, this problem is exacerbated in case of emergencies - a deviation from the expected behavior of stations caused by various external factors and internal processes. In most cases, the procedures for monitoring the status of objects in such situations are not automated. The solution to this problem relies on operators. Management practices in a variety of complex objects of shows that in these situations, operators cannot cope with the task of evaluating and monitoring stations functional states, which leads to a variety of negative consequences.

The problem of control stations is much more complicated in case of so-called distressed situations. Surgical management of complex objects involves immediate dispatching personnel management system that is ergodic (human-machine) systems. Human interventions in such control systems are particularly relevant in case of problem situations. Problem situation - a situation in which there is a sharp contradiction between the planned and actual operation against facility management and operator (management) has no information about what to do to eliminate contradictions. We understand the background to the situation or object as its current state (situation) and the prediction of future behavior object.

To ensure the required level of efficiency of technological monitoring , there is no such technology Evaluation of complex technical objects , which would from a single methodological approach to ground and form a unified set of software and algorithmic processing tools and analysis used in the monitoring of measuring data and synthesize the automated execution system means of monitoring the state - for specific application conditions using invariant models of the processes taking place in the objects , which in turn is due to the absence so far of experience creating and operating large-scale uniform appropriate software. For these vehicles do not address problems of distributed computing as part of the monitoring system, a system of mathematical models adequately controlled processes and phenomena, and focused on their implementation in the existing software and hardware environment. Furthermore, no single technology is developing software to solve specific problems monitoring is not resolved a number of other related issues. All this allows achieving acceptable performance monitoring system operation, and thus the success of all management functions CTO. One of the main features of modern complex technical systems is that their structure and parameters at different stages of the life cycle of change under the influence of objective and subjective reasons. In these circumstances, to increase (store) level of performance and capabilities necessary to manage their agencies (including reconfiguration control structures). Thus the running structural dynamics are understood process of formation and implementation of control actions, providing a transition from the current control systems at the right (synthesized) multifactorial macrostate. Such problems can be successfully solved using intelligent mechanisms used by the operator or involved in the program-technical complex system administration. Intelligent service based on its operational thinking, its ability to display, set by thinking the problem situation. It is necessary to present it in the form of certain elements trigger images of these items and based on them to create a plan for future action by management. If management actions clearly come out of the situation and the need for such action strictly defined program of action, regardless of the complexity of such activities include service to the jet. The difference between the reactions and intellectual processes is the quality of decisions and the basis of decisions made in intelligent action of the operator is its thought patterns. Model thinking has all the information about the data describing the stations, the tool by which converted the data and information about a logical sequence of process management. For targeted treatment of this information model uses inductive thinking and deductive mechanisms. Inductive mechanisms of thinking - a learning and adaptation. Information for these mechanisms has knowledge about objects and object control region, which documented and can be transmitted from person to person during training. Deductive thinking mechanism - a process of analysis and classification management, planning, choice and decision making, diagnosis, and so on. Information for deductive thinking is the mechanism status information against facility management that operators receive from the means of information.

At this time, there are various options controls the structural dynamics of the of control systems. Among them are, first of all: changing the ways objectives of the operation , their content, sequence of different conditions; movement in space of individual elements and subsystems of control system; redistribution and decentralization of functions, tasks, control algorithms , information flow between levels of control systems; the flexible (abbreviated) technology management; reconfiguration of structures.

Solving the problem of managing the structural dynamics research suggests the following classes of problems : the problem of analyzing structural dynamics of control systems problem assessment (observation) structural conditions and structural dynamics of control systems synthesis problem of optimal control technologies and applications in structural dynamics under different conditions (including problems of synthesis technology monitoring states and its major elements of control systems - complex technical objects).

Control problems in structural dynamics of its contents belong to the class of problems in structural and functional synthesis of form of control systems and the formation of the control programs of development. The main feature of the difficulties and solve the problems of this class is as follows. Determination of optimal control programs basic elements and subsystems of control systems can be performed only after we know list of functions and algorithms for data processing and management, which should be implemented in these elements and subsystems. In turn, the division of functions and algorithms but of control systems elements and subsystems depends on the structure and parameters of the laws of the control data elements and subsystems. The difficulty of solving this controversial situation is exacerbated by the fact that the impact of different reasons over time changes the composition and structure of control systems at different stages of its life cycle. In addition, management processes implemented structural dynamics of control systems usually essentially insurmountable in terms of information and time constraints associated with incompleteness, uncertainty, imprecision and inconsistency as the source data and the information that comes (formed) during operation the systems. To date, the class of problems considered structural and functional development of the synthesis and control of control systems investigated deeply enough. These new scientific and practical results within the following areas of research [142]:

- Synthesis of technological structure of control systems under certain laws of functioning of major elements and sub- control systems (1st line of research);

- Synthesis of functional structure of control systems or, in other words, the synthesis of control programs and basic elements of subsystems with known technical structure of control systems (2nd line of research);

- Synthesis software creation and development of new generations of control systems without phase joint functioning of the current of control systems and of control systems implemented (3rd line of research);

- Simultaneous synthesis multifactorial of control systems at different stages of their life cycle (4th line of research).

In modern terms is quite urgent to develop the theory of structural dynamics of control systems that enables a unified approach to management positions multistructured synthesis solutions to of control systems at different stages of their life cycle. This theory should be formed within the interdisciplinary field of scientific knowledge and based on the results obtained so far in the classical control theory in operations research in artificial intelligence in systems theory and systems analysis. The last two research areas will continue to make the transition from slightly structured correctly structured setting to control problems structural dynamics of control systems.

The most important feature of the scientific and technological revolution is happening at this time is that as its development is becoming increasingly important consideration in the complexity of factors currently existing and emerging technical and complex systems [143,144]. In this case received widespread view that the central concept around which focuses " movement system " in modern science is the concept of a complex system. So before you move on to directly address the problem of managing the structural dynamics of complex technical objects and systems, briefly discuss the interpretation of terms and definitions that will be needed in the future.

The main functions of technological monitoring subsystem and it`s structure (fig.1) were developed based on the analysis of technological monitoring problems. This subsystem provides a comprehensive treatment of the input - output information, identifying patterns, analysis of work situations and technological forecasting.

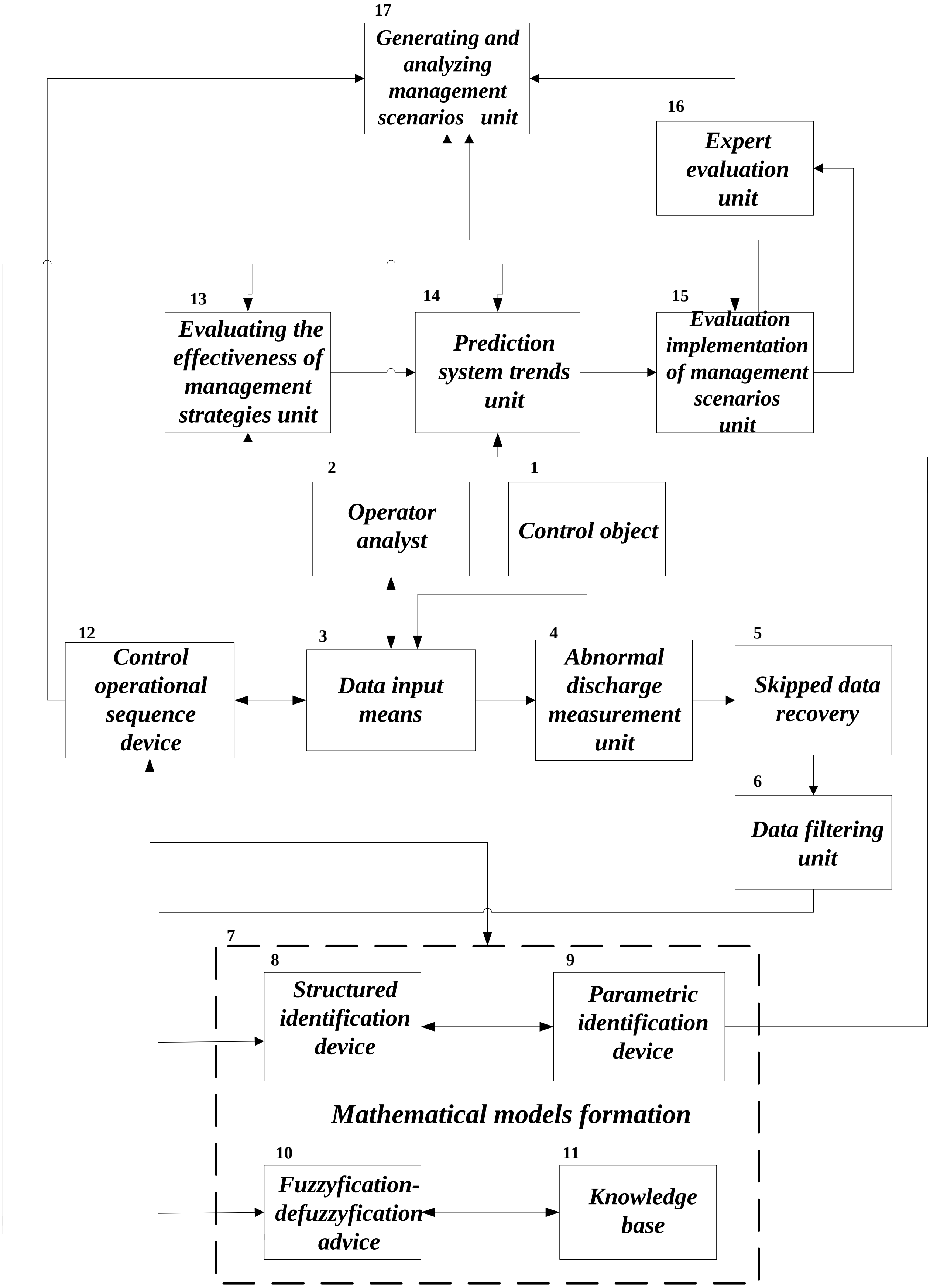

Figure1. Block diagram of the technological monitoring subsystem.

For efficient process control as part of computer- integrated systems proposed structure allows devices using structural and parametric identification of diverse mathematical models developed for the purposes of prediction and control.

To evaluate the decisions made by management and their implementation on-site management unit is used for evaluating the effectiveness of strategies control that allows together with the block forecasting system to estimate trends in results of operation of process control and establish preventive measures to correct deviations in the generated script control , defined in the block assessment and implementation scenarios.

Figure1 shows a block diagram of information- analytical system. Under this scheme information system process monitoring complex organizational and technical system includes control object 1, data input means 3 having feedback from the workplace 2 operators analyst and connected in series to the 4 abnormal discharge measurement unit 5 skipped data recovery , data filtering unit 6 , which is connected to the block 7 the formation of mathematical models, which in turn contains a structural identification device 8 and 9 parameter identification device, fuzzification - defuzzification device 10 having feedback knowledge base of 11; block 7 of forming mathematical models on the one hand connected to the control operational sequence device 12, and on the other - with the unit 13 for evaluating the effectiveness of management strategies , prediction system trends unit 14, and block 15 reviews implementation of management scenarios from which the information is sent to the block 16 expert evaluation, and the block 17 for generating and analyzing scenarios of management.

This structure of the system works as follows: inputs from the control object 1 are introduced as a means of data input through 3, and from the workplace 2 operator analyst. Unit 4 is carried out allocation and elimination of abnormal measurements in the input data, and restores the unit 5 spaces available. In block 6 is carried filtering data supplied to unit 7 of forming mathematical models. In this block using devices 8 and 9 structural and parametric identification, respectively, and the device 10 defuzzification phasing - developed mathematical and logical- linguistic intelligence model, which is the basis of knowledge bases 11. Upon this information goes to block 13 for evaluating the effectiveness of management strategies , unit 14 predict system trends, and block 15 reviews implementation management scenarios to assess the performance of the generated script control. Simultaneously, the information is exchanged with the block 7 the formation of mathematical models and control device 12, the sequence of operations that sends data to the block 17 for generating and analyzing scenarios of control. In addition, in the same block of data is transferred from block 16 expert assessments required for the formation of alternative scenarios.

Efficiency of complex production facilities can be greatly enhanced through the use of scripts governance, which is a system of models that reflect the processes of change over time and the conditions of phase coordinates of the object, discrete fixing the fundamental terms of managing transitions to a new qualitative state.

Given multipurpose management technological complex scenarios, provides a variety of situations in facilities management, depending on the priority objectives such as conflict and so on. The basis of the scenario is situationally significant events and relationships between them are determined taking into account the detailed description and transition management processes, such atracctor`s behavior. Decision management scenarios for decision on the basis of dynamic analysis of situations, which is held subsystem process monitoring management system. Monitoring technology allows on the basis of current information on the state of the control object, and the task of the operator to analyze the quantitative and qualitative characteristics of the behavior of the object and prepare the necessary data for the organization of management strategies; decisions on management [145].

In order to see the changes in the objects, there is a need for special studies changes of processes influenced by various factors, including human activities.

It should be noted that the system for monitoring changes in facilities management is not some kind of a new system that requires networking new monitoring stations, power lines and telecommunications, data centers and etc. It is a component of the system of complex technological systems.

Thus, the process of monitoring system to ensure functioning of the management of complex technological systems can identify changes brought about as a result of the operation of the process that require detailed information about the different variations and changes in the environment. Monitoring involves obtaining (or presence) of such information.

Monitoring includes the following main activities:

1. Observations on the factors that affect the environment and the state of the process.

2. Assessment of the actual state of the process.

3. Prognosis of the state of the process and evaluation of the condition.

So technology is a multi-monitor information system. Its main task - to monitor the state of the object, evaluation and prognosis of his condition; determine the intensity of various actions, identifying factors and sources of influence.

Blocks "observation" and "condition prognosis" closely related, as the weather condition of the object is only possible in the presence of representative information on the actual status (direct link). The prognosis on the one hand, implies knowledge of the laws of change of the natural environment, the availability of the scheme and opportunities numerical calculation, the second - direction prediction should largely determine the structure and composition of the observed (feedback).

Information - measuring systems as an information system for monitoring processes, is a component of the control of human interaction with the environment, because information about the current state and trends of the process of change should be the basis for developing measures for decision-making and taken into account when planning of the object. Results of the assessment of existing and projected state of the object, in turn, make it possible to determine the requirements for the subsystem observations (this is what is scientific justification for the monitoring study of the composition and structure of the network and methods of observation).

The data describing the state of the process obtained by observation or prediction should be evaluated depending on the industry in which they are applied (using specially selected criteria). Evaluation aims on the one hand - definition of damage from the impact of various factors on the other - the choice of optimal conditions for and clarify existing provisions. The purpose of these assessments is to determine the allowable loads for the manufacturing process.

It is also an opportunity to consider the impact of external factors on the sensor readings, leading to a distorted representation of the state of the object.

The use of network of diverse sensors makes creating a complex system of data collection, processing and analysis of data should:

- To welcome and formatting sensor signals;

- Generate a vector of characteristics of an object using vector sensors. In order to eliminate redundancy vector performance is optimized;

- To keep the history of the object (data collected for the entire period of observation the object) as "images" (frames) of the current state for several seasons working ethanol plant using a compact data representation techniques, while maintaining the possibility of retrospective analysis.

- "Learn" to recognize the features of normal behavior (change state) of the object and abnormal changes. The process of "learning" should include the natural life cycle of the object associated with changes in external factors (temperature, humidity, etc.) And modes of operation. Study and analysis of changes - two parallel interconnected processes. Initially, the operation of the inevitable false alarms;

- Analyze changes to the localization of abnormalities and assess their significance.

For the classification is necessary to create and maintain knowledge base, taking into account operating experience of similar objects, the results of simulation, expert opinion, and others.

Given the feasibility of the lower stations of ACS DRF, task is to build a top level - of intellectual analysis, monitoring and control .From lower-level process control system, namely of SCADA - system information , by OPC - collectors coming to the top level - the level of a single archive Historian, where the current backup of the database. These laboratory tests come in. zipping through laboratory workstations brokered File collectors.

The only interface that allows for the information to third-party programs on the environment - Archive Historian, is its integrated subsystem Excel Add in, this interface allows you to play at the level of information tables Excel, and then through Excel to transfer to the upper level - smart automated management DRF.

Subsystem process monitoring is realized by integration environment MVTM [146] and developed software in C # environment. In turn, transmits the processed data to the level of production analysis MES level - the level control of production. Processed information through programmatic interfaces of Excel Add in arriving at the level of SCADA – system (fig.2).

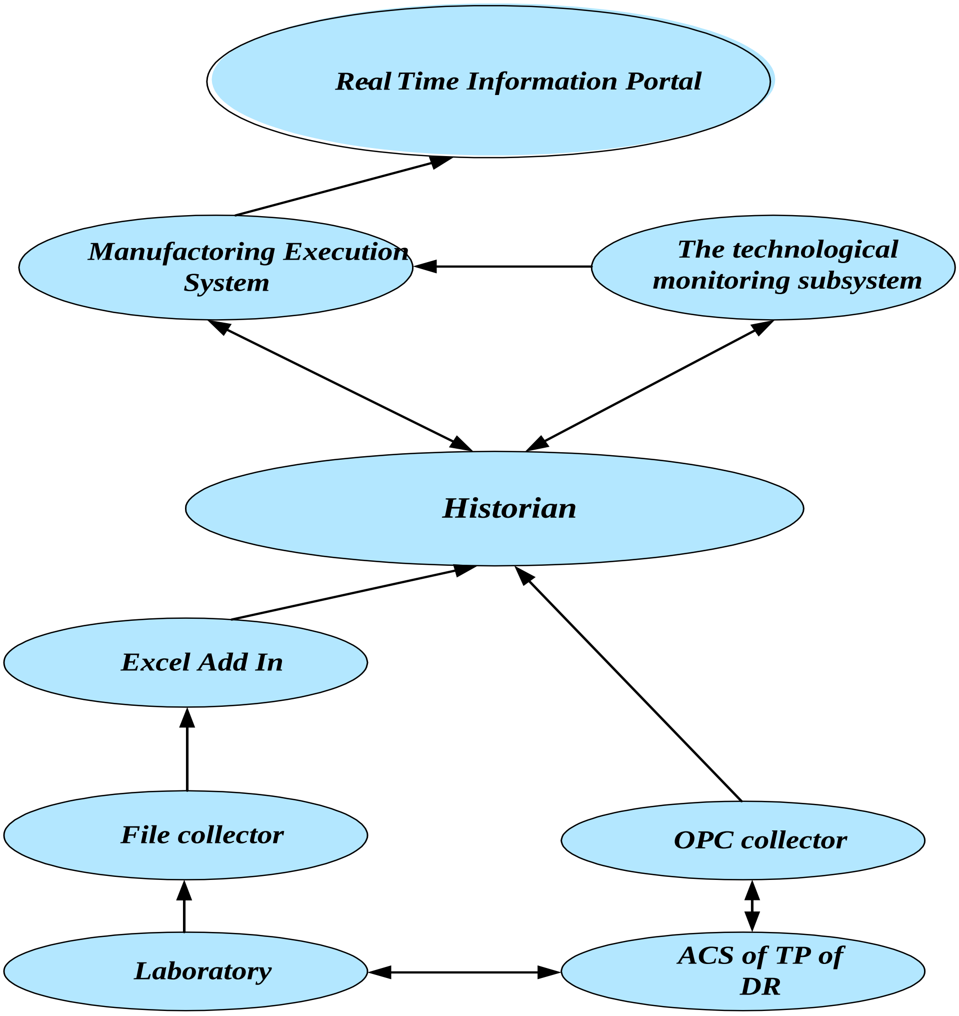

Figure 2. The integration of monitoring subsystem in the information vertical of alcohol production.

To one of the most important phases of management activities related decision-making, which largely determines its effectiveness. Solutions for process control alcohol production are carried out at three levels of organizational management: strategic, tactical and operational, each of which is characterized by its list of issues and problems. FAQ information and technical support of the above multidimensional and multivariate solutions is becoming more urgent.